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Impact of technical landfill centers on floristic diversity (Case of Ras Bouira center)

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ABSTRACT

When human beings try to correct the harmful effects of most of their activities on the environment, they tend to make things more complicated. Good management of human activities can produce good results at the environmental level as well as at the economic and social levels. In this case, the management of household wastes is a good example, since from the first contact of suchwaste with the natural environment, its impact on the latter seems very clear; to this end, and with a view to studying the effect of controlled landfills, also known as CET (technical landfill) on vegetation; The Qualitative study and the monitoring of floristic diversity by the application of vegetation indices indicate a significant variability of vegetation of which 30. 5% of the totality of the species inventoried in the old register are new species adapted to this ecosystem of which 13 new species have been inventoried.

Key words: *Biodiversity, household wastes, controlled landfills.*

Introduction

With the growth of population and the increase of social and economic activities, the increase of solid waste production has become worse. So far, the main way of waste disposal in Algeria is landfill. This technology is often used in developing countries, but often leads to uncontrolled open landfills, where all types of waste are discharged in untreated and mixed forms: household and assimilation, industry, hospitals and agriculture (Kihal, 2015).

The present study relates to the evaluation of the toxicity in plants at the level of the locker of the technical landfill center of ras Bouira. The objective of our study is to know the impact of the technical landfill center of RAS Bouira on the floristic biodiversity. To meet these objectives, we carried out a floristic inventory of the RAS Bouira study area which consists of a quantitative and qualitative analysis of the various significant parameters: overall composition (number of taxa), specific diversity, biological types and biogeographical distribution, to highlight the main factors influencing vegetation cover.

Methodology and sampling

Study area

The CET of Ras Bouira is located 3 km east of the chief town of the wilaya; is a class II center on an area of 10 ha (Fig. 1), only assimilated household waste is authorized to be diverted at site level; Any other waste (toxic, septic, ..) is strictly prohibited.

Fig. 1. Location of the CET of Ras Bouira (Google Earth).

Sampling

In this study, three representative plots of different ages were selected: Plot one (new landfill), Plot two (old landfill), and Plot three (control) (Fig. 2). Various sampling techniques exist, but for this study, we adopted a mixed (subjective) sampling approach as it appeared to be the most effective and suitable for achieving our objectives.

The "line technique" was deemed the most efficient, as it is simple, fast, relatively objective, and applicable to all types of low vegetation. In our case, we chose a 10 m line for sampling. This involved taking readings every 10 cm along the line, which was marked by a graduated tape stretched above the vegetation. Using a needle that was allowed to slide towards the ground, we recorded various species encountered as well as the number of contact points for each species, sand, litter, and coarse elements (Gounot, 1969).

Statistical processing of data

Given the large number of data: 30 readings and 15 species, we deemed it useful to study them to use The statistical method used in this study is factorial analysis (FCA). Its objective is to highlight the relation ships between the environment and vegetation, as well as to distinguish different plant groups.

The factorial analysis of correspondences, developed by Benzecri (1973), applies to qualitative or semi-quantitative data and makes it possible to compare readings two by two from a set of individuals without assigning them a value. particular purpose of visualizing the floristic affinities that exist between plant groups (Akkouche, 2011).

Results and Discussion

Ground surface states

The variation of the ground surface elements in the three sampled stations is illustrated in Figure 3.

According to Figure 3, one notices the dominance of the vegetation compared to the other elements of the soil, especially in the control plot and in the old plot; where vegetation exceeds 43%. While the new locker marks a slight decrease, which could be due to the instability of the products resulting from bio-

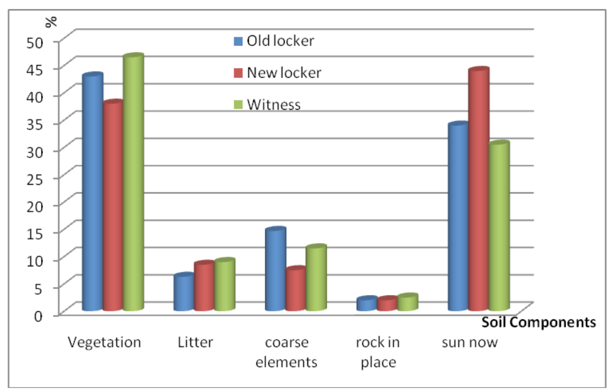


Fig. 3. Occupation of different elements on the ground surface.

Fig. 2. Different traps sampled (Authors, 2017)

degradation, this locker has been in operation since 2009.

While more or less important recoveries in coarse elements are recorded in the old and the control, these outcrops rise to the surface of the ground, under the effect of the heaping up and the reorganization of the layers of waste and the ground after the closing of the lockers, while the witness has its natural outcrops without human intervention. Coarse elements are made up of blocks, pebbles and gravel with a diameter greater than 2 mm and come either from the decomposition of the parent rock or from upstream.

The litter rate is low in general, slightly high in the control which has significant vegetation.

According to Table 1 and Figure 4, Hemi cryptophytes dominate with a very slight difference between the three compartments.

For the witness; Hemi cryptophytes occupy 75% of the space, followed by Therophytes (25%), For the new locker; Hemi cryptophytes colonize 70% of the space, while the rest is occupied by Therophytes (30%).

For the old locker, we notice the appearance of Geophytes with a dominance of 7.69%, while Hemicryptophytes (69.23%), and Therophytes (23.08%), still occupying the first and second position.

Hemicryptophytes generally prefer moist environments rich in organic matter, their dominance is recorded in the three stations, which is due to the nature of the substrate; and what requires a soil test.

The presence of Geophytes is marked only in the old locker, their presence increases with rainfall and cold (Mimouni, 2014), in our case it could be due to the age and seniority of the locker, but also to the nature of the leachate, which contains pollution of the nitrogen type (ammonia, NH_4), of the carbon type (organic waste, COD), and heavy metals.

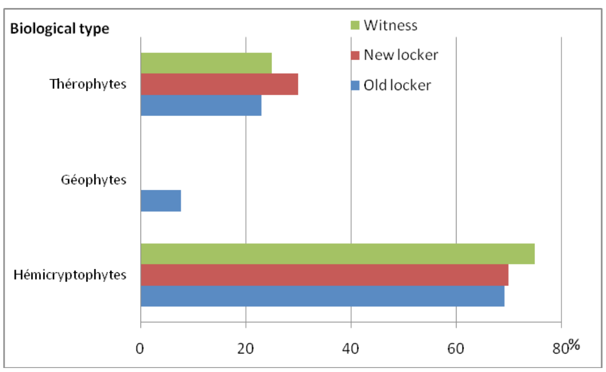


Fig. 4. Raw biological spectra of the three plots.

Actual biological spectra

Actual biological spectra are based on the actual coverage of each biological type existing in all the readings compared to the total number of flora in the study plot (Aïssiou, 2009).

Figure 5 reveals the strong contribution of Hemicryptophytes to the plant cover, primarily represented by the Asteraceae family, which occupies the largest part of the soil. Therophytes rank second in terms of coverage, showing a slight increase in the new compartment. This therophytization is primarily influenced by the available water quantity and its retention in the soil, especially during the growing season. According to Daget (1980), therophytism

Table 1. Floristic list

Genus-species	Family	Biological type	Biogeographic type
Malva syvestris	Malvaceae	Hé	Euras
Lolium perenne .l	Poaceae	Hé	Circumbor
Calandula arvensis	Astéraceae	Th	Sub- méd
Plantago lanceolata	Plantaginaceae	Th	Euras
Trifolium campestre	Fabaceae	Hé	Paléo-temp
Carum carvi .l	Apiaceae	Hé	End
Scolymus maculatus	Asteraceae	Hé	Circum méd
Cichorium intybus.l	Astéraceae	Hé	Med
Silybum marianum	Astéraceae	Hé	Cosm
Hordeum murinum	Poaceae	Th	Circumbor
Taraxacum officinale	Astéraceae	Hé	Eur
Urtica dioica.l	Urticaceae	Hé	Cosm
Stellaria media.l	Caryophyllaceae	Th	Euras
Polygonum aviculare	Polygonaceae	Th	Cosm
Matricaria recutita L	Astéraceae	Ge	Méd

is an adaptive strategy in response to unfavorable conditions and a form of resistance to climatic challenges. This is further confirmed by the reduced rainfall recorded over the past three years in Bouira. Studies by Danin and Orshan (1990) and Floret et al., (1990) indicate that therophytes are well-adapted to drought.

Geophytes have a very low coverage percentage in the old locker, accounting for only 0.21%.

Analysis of Table 1 reveals a similarity between the phytogeographic biological spectra of the new compartment and the control, both belonging to the Mediterranean region. The northern element (Eurasian, Circumboreal) is introduced into North Africa during more humid periods preceding the Quaternary period (Maire, 1926).

On the other hand, the old locker is dominated by the cosmopolitan element and the Mediterranean ensemble.

Alpha diversity

It emerges from the analysis of Table 2, that the values of the SHANNON index are very close in general, with a slight increase in the old compartment H'=1.59, compared to 1.52 in the control and 1.47 in the new compartment. These results allowed us to say that the diversity index (H') increases with specific richness (Ramade, 1994; Lacoste and Salalon 1999). This is confirmed by the evenness index, which records the highest value in the old compartment. It tends towards 0 when almost all of the numbers correspond to a single species in the stand and tends towards 1 when each of the species is represented by a similar number of individuals (Ramade, 1994). This means that the seniority and age of the trap has a positive effect on the specific diversity, which could be explained by the improvement in the quality of the soil , which is enriched by

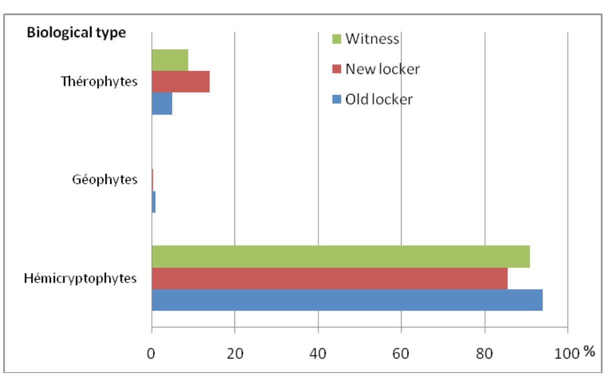


Fig. 5. Real biological spectra of the three plots.

the biodegradation of waste.

Beta diversity (SORENSEN similarity index "SI")

Since it evaluates the resemblance between two records by establishing the relationship between common species, the similarity index makes it possible to make a comparison between two sites.

Table 3. SORENSEN index of the study Stations.

Stations	New locker/ Witness	Old locker / Witness	New locker/Old locker
Similarity Index 2c / (a+b) ×100	90.9	80	69.5

According to Table 3, the Sorensen similarity index shows a very high similarity between the control and the new compartment, which is expected considering the relatively young age of the new locker (7 years). However, the similarity decreases when comparing the control with the old locker (16 years). The index indicates a 69.5% similarity between the flora of the new compartment and the old locker, meaning that 30.5% of the species recorded in the old locker are new species that have adapted to this ecosystem. This suggests significant vegetation dynamics and a low similarity in specific diversity between the compartments. These findings could be attributed to the changes in the chemical composition of the soil resulting from waste decomposition.

Statistical processing of the data

The factorial analysis of the correspondences makes it possible to highlight the ecological factors which influence the plant groups of the study area: thanks to the examination of factorial maps obtained with

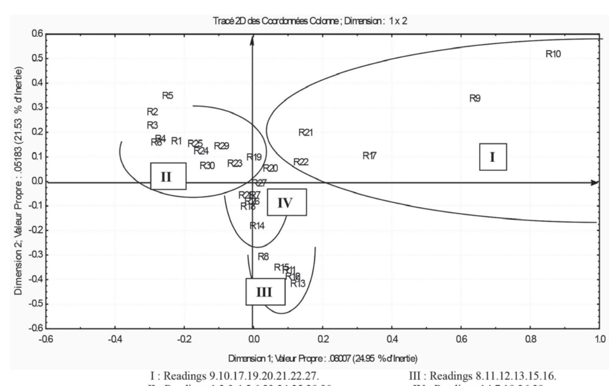


Fig. 6. Factorial map of readings according to the plane of axes 1-2

Table 2. SHANNON "H'i" and evenness "E" indices of three stations.

Diversity paramete	New locker/	Old locker	Witness
Specific Richness	10	13	12
Shannon IndexH'= -ΣPiLog2Pi	1,47	1.59	1.52
Evenness E = H'/ Log2S	0,37	0,47	0.42

the first axes which are more significant. It is based on readings and species with high relative (CTR) and absolute (CTA) contributions.

Identification of plant groups and their ecological and floristic characterizations

Identification of plant groups and their ecological and floristic characteristics are based on the varied floristic composition, which is influenced by multiple ecological or anthropozoic histories (AidoudLounis, 1997).

A Factorial Correspondence Analysis (FCA) was conducted on 30 surveys and 15 species, considering the Abundance-dominance of the species in each survey. The main objective was to find significant ecological patterns in the arrangement of the readings. The ecological interpretation of the arrangement, based on the preferred elongation directions of the point clouds, helps to seek the ecological significance of the corresponding factorial axes.

The maps (Figures 6 and 7) represent the readings in planes (1-2) and (2-3), showing point clouds spreading along axes 1, 2, and 3.

Ecological and floristic characterization of the groupings of the factorial maps of the surveys

According to plane 1-2

The factorial plane (1-2) illustrated in figure 6 shows four groups of neighboring ecological affinities (Ozenda, 1982).

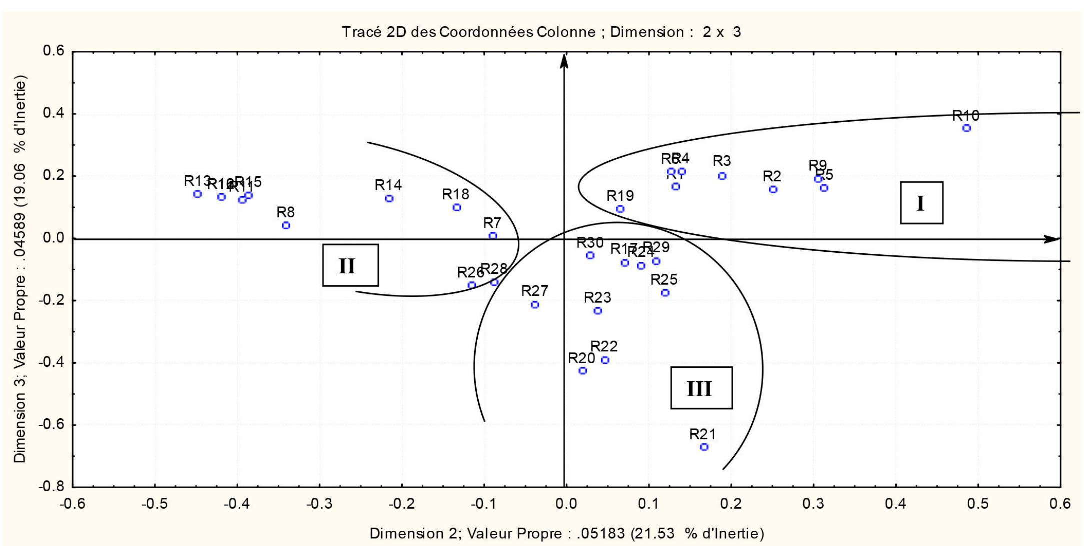
The use of plan 1-2 (Figure 6) highlights four groupings :

Group I: groups together readings taken in the old compartment and the witness; these statements are characterized by a low overlap and a low number of species.

Group II: combines the readings taken in the new compartment and the witness; these readings are characterized by an overlap and a large number of species.

Group III: includes readings made only in the old trap; characterized by a very low overlap represented by two species on average.

Group IV: includes surveys carried out in the three plots; characterized by an average recovery and specific richness.



I : Readings 1.2.3.4.5.6.9.10.19. III : Readings 17.20.21.22.23.24.25.26.27.28.29.30.

II : Readings 7.8.11.12.13.14.15.16.18.

Fig. 7. Factorial map of readings according to the plane of axes 2-3.

According to the 2-3 plan

According to the factorial plan (2-3) depicted in Figure 7, three distinct groups with similar ecological affinities can be identified (Ozenda, 1982).

The use of plan 2-3 (Figure 7) highlights three groupings:

Group I: groups together the majority of the readings carried out in the new one and some readings from the old compartment.

Group II: gathers the majority of readings carried out in the old compartment.

Group III: encompasses all the readings taken in the control.

Ecological significance of the factorial axes

This analysis allowed us to identify the ecological factors that influence the distribution of plant groups in the study area, represented by the factorial axes.

The analysis was conducted on the 1-2 and 2-3 factorial planes, revealing a well-structured dataset.

Along axis 1 in the 1-2 plane, groups I and III are opposed to each other, with group II on the negative side. Therefore, we can infer that axis 1 represents species richness, which reflects soil fertility.

Along axis 2, groups I and II are on the positive side, while groups III and IV are on the negative side. This suggests that axis 2 represents soil moisture.

Along axis 3, groups I and II are on the positive side, opposing group III. Hence, we can conclude that axis 3 illustrates the age and seniority of the landfill.

Conclusion

The conventional method of solid waste disposal in Algeria primarily relies on landfilling, which is the most commonly used approach due to its lower cost compared to other methods.

The qualitative study conducted on the vegetation of the Ras Bouira Technical Landfill (CET) provided insights into floristic diversity:

The study area comprised 15 species belonging to 9 families, with the Asteraceae family being the most dominant (40%), followed by the Poaceae family (13.33%).

The analysis of floristic composition at the CET revealed a prevalence of Hemicryptophytes, followed by Therophytes. The distribution of biological types in the study area followed the pattern: Hemicryptophytes > Therophytes > Geophytes.

The assessment of actual biological spectra highlighted the significant contribution of Hemicryptophytes compared to Therophytes and Geophytes.

Regarding phytogeographic spectra, the Cosmopolitan biogeographic type exhibited the highest prevalence, followed by Eurasian, Circumboreal, and Mediterranean elements.

On the quantitative level, the monitoring of floristic diversity using vegetation indices demonstrated substantial vegetation variability. Notably, 30.5% of all species recorded in the old registry were newly identified species adapted to this ecosystem, with 13 new species being documented.

Declarations

Conflict of interest: No conflict of interest.
Consent for Publication: Upon acceptance, we give the consent to publish the article.

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